Foreword

This project has given me much knowledge and inspiration for further research.

I would like to thank my advisor Jo Herstad for guidance and inspiration, my sister Susanne, Øystein D. Johansen, all members of the I-tema project, my fellow student Morten Jacobsen, friends and family for discussions and input. And especially my wife Hanne Beate for unlimited support.

Andreas Hjertø Wiik
Oslo, May 02, 2006
Squeeze me.

Come on and squeeze me.

Come on and squeeze me like you do.

I'm so in love with you.

-Pete Townshend, The Who 1975
Abstract

This is a master thesis (60 credits) written at the Department of Informatics, University of Oslo.

The goals of the thesis are:

1. To describe research about informality in communication.
2. To describe research about the application of touch in communication.
3. By way of scenarios, illustrate how touch can be used to support informal, social interaction in a distributed environment.

I describe background research and theories within the fields of HCI and CSCW. I use this and research on haptics, informal communication and scenarios to shed light upon and discuss the theme of the thesis.

I found that research supports:

- Informal communication is important in all areas of our lives, professionally, privately and socially.
- Systems for computer mediated human to human communication benefits from supporting informal communication.
- That touch is a powerful means of communication, and that computer mediated touch can convey information between people.
- The field of haptics is an emerging popular field right now.
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1 Introduction

John is a devoted football fan, and his team is playing an important match. Sadly he is stuck in a very important meeting with very important people. His best friend, George, is watching the match. Luckily they both have the Squeezeball\(^1\) connected to their mobiles. John is doing a presentation, and has the mobile on silent and vibration off, but the Squeezeball is in his pocket. In the middle of the presentation it starts pulsating in a patterns he recognizes and knows his friend has just told him that his team is under by one goal. Despite his disappointment he continues the presentation, but in a slightly lower key. Near the end of the presentation he receives another pulse, and another, and then the ball seems to go crazy and he knows his team has won 2-1, he casually puts his hand in his pocket and squeezes back while he finishes the presentation with a big smile.

This is a scenario illustrating the use of informal haptic computer mediated human to human communication. Although I will not recommend receiving football scores in the middle of important meetings, I claim that the friends in the scenario had a valuable social interaction. One that would not have been possible through visual or audible communication media.

I want to explore new frontiers of computer mediated human to human communication, specifically haptic\(^2\) and tactile forms of communication. I want to combine this with the notion of informal communication\(^3\). This has led me to the fields of HCI and CSCW. My goal is to describe these fields of research and, combine them to describe Informal Haptic Computer Mediated Human to Human Communication.

I believe this can be an important contribution to current research on computer mediated human to human communication, which today focuses mostly on formal structures or how

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1 The Squeezeball is a conceptual device for computer mediated human to human communication. It is a ball which fits into your hand. See chapter 5.1 for a full description.
2 Haptic sensing is defined as the use of motor behaviours in combination with touch to identify objects. See chapter 3.1.2.1.
3 See chapter 3.2.1
to formalize structures like workflows in organizations, or simulation of physical cooperation, like sharing of documents or emulation of face to face communication.

The importance of informal communication and touch in private life, social life and at work is significant\(^1\). Brief conversations in the hallways or by the coffee machine is the oil in an organization and also functions as glue to bind colleagues together socially. Ideas are spawned, misunderstandings are corrected and small bits of crucial information are passed and distributed in these settings.

The use of touch is not as, excuse my pun, tangible and it is hard to show the importance of it in an organization. On the other hand, colleagues touch each other, so it must have some value which might be lost in a distributed work environment, where telephones and other forms of communication technology is predominant and face to face conversations are more rare than in work environments where people work in the same shared physical place.

I will not constrict my research to workplaces, but will include social and private areas of human interaction as well. In our part of the world these borders are not as clearly defined as they used to be because of new communication technology.

The goal of this thesis is not to discuss specific technical solutions for conveying the sense of touch through electronics. That is also why I will not discuss communication systems made especially for disabled people. There is a lot of interesting research in those fields, but I want to explore the effects and possible uses of informal haptic computer mediated communication between all kinds of people.

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\(^1\) See chapter 3.1.2.3
1.1 Why

Touch is a significant part of how people communicate with each other. This channel is not open in current computer mediated communication systems, at the same time as we use these communication systems more and more. I gather from my research on the fields of CSCW and HCI that haptics has not been the predominant focus within these fields. But there is much current research going on and this is clearly an emerging field.

The ability to work distributed and being able to reach and be reached anywhere has obscured the border between work and home, and brought work into our family and private lives in a profound way. That is why I will focus not only on work, but private and social parts of our lives as well. These are all interconnected and one affects the others.

The development of mobile phones and PDA’s\(^1\) is fast paced. New capabilities in these devices have opened up for new innovations. Mobile Telephones and powerful computers are already merged into one small mobile device. New mobile phones support for example J2ME\(^2\) and have Bluetooth integrated. This enables developers to create independent applications and configure the phone to do new things. You could for example connect it to a haptic device.

1.1.1 Some Background

Numerous researches [1,2,3,4] have shown that creating a good formal tool for cooperation can be difficult. The systems seem to be too rigid and people use them in ways not intended by the designers. It seems like one thing one can do to help is to provide informal channels of communication between users. This functions as oil in an otherwise rigid system.

Sahay [1] showed how social structures have an impact on an information system. The system was not used and did not function as intended because the nature and importance

1  Personal Digital Assistant

1.1.1 Some Background

of the social structures of the people who were supposed to use it were overlooked. Orlikowski [4] claims that the results of her study suggest that people’s mental models and organizations’ structure and culture significantly influence how groupware is implemented and used. She also claims that:

“While some have discussed the potential for such technologies to enhance organizational effectiveness [...], others have suggested that the implementation of such technologies is more difficult and yields more unintended consequences than is typically acknowledged [...].”[4]

Harrison and Dourish [3] discuss how spatial metaphors are often used in the design of collaborative computational environments. These designs are based on the assumption that, since many aspects of our behaviour seem to be organised around spatial elements of the everyday world, then we can carry over these patterns of behaviour to virtual environments by designing them around the same affordances for action and interaction that the everyday world exhibits--doors, windows, walls, distance, proximity or whatever.

But they argue that there is a difference between Space and Place. A space can become a place if people appropriate it, that is, make it their own through adaptation and their use of the space. They say this is the goal for the design of collaborative computational environments. But we can not really implement appropriation in a system, but we can try to support the processes needed for people to appropriate a space.

“When my “virtual door” absolutely controls access to my virtual presence in a media space, then the opportunity is lost for an appropriate social interpretation of a “closed door”. My ability to appropriate elements of the world and turn the into cues for availability disappears. This is the paradox of design around spatial metaphors. “[3]

“After all, a virtual world filled with virtual offices and virtual desks isn’t populated by virtual people, but by real ones.”[3]

Nardi [2] shows how much IM	extsuperscript{1} was used as a social tool and how important it is for people to have a sense of social connection to others. And I think IM supports the place analogy of Harrison and Dourish[3], by being lightweight and versatile, people appropriated it as a

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1 Instant messaging. For example MSN and ICQ.
1.1.1 Some Background

social and professional tool. It also adds to the placeness of other tools, and even to the 
physical office environment itself. What Nardi calls outeraction are also all the things that 
help us appropriate a space and make it a place.

I conclude from these researches that to make systems work better we need tools for 
social interaction. Such a system needs to support informality and intimacy. So why not 
take things one step further? And create a system for person to person communication 
through touch. It seemed like the logical step to take, when you think about how important 
touch and informality is to most people in their communication with family, friends, 
colleagues and even strangers. And what is more fitting as a tool for appropriation? When 
you touch something it is a very effective way of familiarizing yourself with it. And if you 
keep it in your pocket and carry it around, you develop a sense of ownership and you have 
literally appropriated it. If you touch someone, often you instantly get a feeling of intimacy, 
good or bad, and you feel closer to the person. From the formal handshake, pricking on 
the shoulder to get attention and to more intimate forms of touching.

Haptic and tactile communication is very interesting and promising. It is not a new form of 
communication, nor is it a substitute for speech or text. It can be a supplement, like IM 
and SMS is not a substitute for telephone or email. I see the research on the use of IM as 
closely related to tactile/haptic communication. The research I have read [2,92], and my 
own experience has shown me that IM is a very good tool for the right things, and a good 
supplement to other types of person-to-person communication.

So, I want to research and describe computer mediated haptic and informal 
communication and suggest how it can be supported/implemented in communication 
systems. This is also relevant with my participation in the I-Tema¹ project.

¹ See chapter 4
1.2 What am I Looking for?

I want to explore current research in mainly the fields of CSCW and HCI. And use this to shed light on my idea of *Informal Haptic Computer Mediated Human to Human Communication*.

Focus on the importance of touch as a form of human communication has traditionally been lacking in CSCW research. The same can be said about informal communication. I want to show how important it is, and how it can be supported in computer mediated human to human communication and what this can contribute to.

It is not my intention to suggest a system which substitutes physical contact between people, like IM does not substitute letters or face to face conversations. I want to show that the introduction of haptics in this mixture of communication channels we have today will contribute to the richness of it.

1.3 Problem Definition

In this thesis I will:

1. Describe research about informality in communication.
2. Describe research about the application of touch in communication.
3. By way of scenarios, illustrate how touch can be used to support informal social and professional interaction in a distributed environment.

1.4 Method

1.4.1 Culture

First I have to make it clear that I come from a middle-class home with parents with high education, and I live in Norway, one of the richest countries in the world. It has been named the best country in the world to grow up in, several years in a row, by the UN. Norway was, and is, exceptional in the way we appropriated mobile technology, Internet
and other forms of modern technology. Most of the world has never made a phone call\[96\], and problems of CSCW, advanced theories of awareness or new fun gadgets have little or no impact or importance for their lives. In this perspective it can be argued that this thesis is unimportant, a waste of time and even decadent. On the other hand, technology has always had the potential to help people and make our lives better, or worse. Exploration and development has always been part of being human, and you can not separate the “good” science from the silly or “evil” science. They are all small parts of each other.

My point here is that everything I write in this thesis has to be viewed in the light of my cultural background. So when I talk about how important something is, I probably mean important for some relatively rich people in the western industrialised part of the world.

### 1.4.2 Research Design

The choice of research design is a field of research in its own right. According to Halvorsen [5] you must consider several issues in choosing a research design: "Every research plan must consider what the ideal is, and what is practical." The research design does not have to be the best method or alternative since we have limited resources at hand. Costs, time and access to analytical tools are critical resources here. The purpose is to create a design that ties the beginning and the end of this research report into a logical constructed framework, that ensures the proof (data and literature) which are gathered in, correlates with the problem definition.

### 1.4.3 Exploratory Research

Exploratory research, is often used [6, 7, 8] in the preliminary stages of a research project when the levels of uncertainty and of general ignorance of the subject in question are at their highest. This type of research is characterised by a high degree of flexibility. The flexibility arises from a desire to learn from the experience of the investigation and from the need to avoid being blinkered by any preconceived notions (Webb, 1992). I use this methodology because my research suggests that the area I am entering is relatively uncharted, so it is important to keep an open mind and there are no obvious specific fields within this area to focus on. Hopefully, this research might reveal such fields.
1.4.3 Exploratory Research

I have collected literature on subjects I believe to be relevant to the project. By reading I have acquired a deeper understanding and found additional sources for information. I used other researchers' empirical material and theories and I combined them to shed light on new areas of research. I frequently found new, recently published articles on subjects that overlap my research, which means this is an emerging field of research. Exploratory research is not intended to provide conclusive evidence to map out a course of action, but to build more of a framework for later research to provide such evidence [9]. Mostly, this method examines qualitative data.

In the following I will go through several fields of research. Some are well known and the research can be said to be of high quality because it has had time to mature under criticism from the scientific world. Other fields are emerging and does not provide any answers, just more questions, but they help in charting out the territory so our efforts become more focused.

1.4.4 Scenarios

Carroll [10] claims that the predominant approach to system design is to control the complexities and fluidity of design through techniques that filter the information considered and decompose the problems to be solved. Scenario-based design belongs to a tradition complementary to this, but with a different approach. The latter tradition seeks to exploit the complexity and fluidity of design by trying to learn more about the structure and dynamics of the problem domain, by trying to see the situation in many different ways, and by interacting intimately with the concrete elements of the situation [11,12,13,14]. In scenario-based design, descriptions of how people accomplish tasks are a primary working design representation. System design is often about envisioning and facilitating new ways of doing things and new things to do. Maintaining a continuous focus on situations of, and consequences for, human work and activity promotes learning about the structure and dynamics of problem domains, seeing usage situations from different perspectives, and managing trade-offs to reach usable and effective design outcomes [15,16].
1.4.4 Scenarios

“Computers are more than just functionality.”[10] Any computer or communication system unavoidably restructure human activities, creating new possibilities as well as new difficulties. When we analyse and design systems and software we need means to talk about how they may transform and/or be constrained by the contexts of user activity.

A direct approach is to explicitly envision and document typical and significant user activities early and continuously in the development process. Such descriptions, often called “scenarios”, support reasoning about situations of use, even before those situations are actually created. Scenarios are stories about people and their activities.

As an addition to my exploratory research, I will present such stories. In these scenarios I describe hypothetical situations and uses of a haptic/tactile device for communication. This is in line with my exploratory approach. This field is still in its infancy and there are no systems widely in use today that I can collect empirical data from. Creating a physical prototype and testing it is beyond the resources of time and money of this project. I have however, a clear idea of such a device which features in the scenarios. This can be a valuable first step in designing such a system. See chapter 5 for a full description of the Squeezeball and the scenarios.

1.5 Structure of Thesis

Chapter 1. Introduction
Here I describe my motivation, background and problem definition.

Chapter 2. Empirical studies on and examples of telehaptic systems
A presentation of some studies of prototypes of telehaptic systems and a description of some systems in use in the real world.

Chapter 3. Theory
This is the main part of the thesis, where I present definitions of terms and research on the fields I believe are relevant for my problem definition.
1.5 Structure of Thesis

Chapter 4. Identity and belonging in mobile work: I-TEMA
Here I present the I-TEMA project.

Chapter 5. Scenarios
My idea of an informal telehaptic system, and scenarios for use of this system and other.

Chapter 6. Discussion
What I have done, and a discussion of findings.

Chapter 7. Conclusion
Conclusion, and suggestions for future work.
2 Empirical Studies on, and Examples of Telehaptic Systems

There are many commercial tangible devices for man machine interaction and, but not too many human-human interaction devices. Karon MacLean, Associate Professor Dept. of Computer Science at the University of British Columbia claims there are many prototype haptic-feedback systems existing for surgeons, scientists, fighter pilots, astronauts, and crane operators. MacLean feels that these devices also have a place in our everyday world, with the potential to change the way we control home environment systems, view streaming media or drive our cars. [17] I agree with this and I am specifically interested in these types of devices for human-human interaction.

I will describe some such existing devices in general use and some studies on prototypes in this chapter. I have dedicated two sub chapters to two systems which I find particularly relevant for this thesis. This chapter also functions as a background for chapter 3, which describes background research in different fields which, in turn are the foundations of the systems described here. I choose to present this chapter first in order to make it clear why I go through the research I do later.

Devices that utilize touch are becoming increasingly popular. The mobile phone usually has a vibrator to notify the user of events. Fighter pilots have a haptic device in the trigger of their weapons which tells them when to press the trigger. This proves to be a lot faster than to notify the pilot through a message on their screen or a flashing light. Visual notification involves several processes in the brain and nerve system where the brain has to interpret the image and then decide to send a message to the index finger. Through touch it is more of a reflex and the pilot presses the trigger without thinking (which perhaps is not always a good idea). This is because of the properties of cognitive load which I describe later.¹

A somewhat more peaceful example is an American Football referee. Motorola have a system which use haptic devices. At the push of a button, a coach can challenge a call and signal the referee — who is wearing a Motorola vibrating pager — and the replay

¹ See chapter 3.1.2
booth simultaneously. This technology makes the game more efficient and exciting for everyone involved. Instant replay first debuted in the NFL in 1986, using video tape machines. But the experiment was abandoned five years later, after owners complained the system was too poky and referees sometimes wound up making the wrong call anyway. Instant replay came back in 1999, using swifter digital technology that allowed officials to quickly review a play from seven different angles.

Under the current system, coaches carry a belt pack, the size of a pager, with two buttons. If coaches want to challenge the play, they must press both buttons at the same time -- triggering a vibrating pager worn by officials on the field and alerting the replay booth overlooking the field. [18,19]

Soetens Offside System [20] for football works like this:

"Two extra Assistant Referee's are needed, one for each team A and B. The extra Assistant Referee A emits a signal A if the ball is played by team A and the extra Assistant Referee B emits a signal B if the ball is played by team B. The actual Assistant Referee A activates his vibrator when a player from team A is in the offside position. Activating first his vibrator, his flag starts to vibrate if team A plays the ball. The confirmation that a player is offside."

The vibration in this system is used because the Assistant Referee has to keep his eyes on the players to monitor if any of them are in the offside position. Otherwise she would have to look at the extra assistant referee and possibly miss important events on the field or signals from the extra assistant referee.

All the mentioned systems are basically one way communication devices, of real two way devices, the list is shorter, at least for systems in ordinary use. Brave et al.[91] mentions some projects that have created such interactive systems. One of the first attempts at multi-user force-feedback interaction, Telephonic Arm Wrestling [21], provided a basic mechanism to simulate the feeling of arm wrestling over a telephone line. Denta-Dentata
[22] is an elementary "hand holding" device that communicates one bit of information over the phone line to activate a mechanism that can squeeze a user's hand. *Feather, Scent, and Shaker* [23] consists of a pair of linked "shaker" objects. Shaking one object causes the other to vibrate, and vice-versa. Fogg *et al.* [24] describe *HandJive*, a pair of linked hand-held objects for playing haptic games. Each object has a joystick-like controller that can be moved vertically or horizontally. A horizontal displacement of the local object causes a vertical displacement in the remote object, and vice-versa. *Kinesthetic Constructions* by Schena [25] explores the application of bilateral force-feedback to interpersonal communication. This is a network of large modern sculptures distributed around the world, where parts of each sculpture are haptically connected to sculptures at other locations.

In *Brave* [26], they discovered some very interesting differences between cooperation using visual and haptic media. They performed experiments where people were to cooperate or compete, using visual or haptic media with a partner in two tasks (a maze and the prisoners dilemma). In reality there was no partner, just a computer. They found, among other things:

1. Contrary to expectations, cooperative participants trusted their ostensible partner less when interacting via haptics as compared to visuals.

2. Touch participants felt more powerful in the competitive condition, but less powerful in the cooperative condition.

3. Under competitive conditions, the participants had much more positive feelings in haptic mode than in visual.

4. Participants liked the competitive partner best in haptic mode.

These are very interesting finds and to me mostly because it at least shows that the haptic channel of communication gives different effects than visual, which in turn shows that touch adds to the richness of the communication.

In Sallnäs *et al.* [27] they performed what I call a traditional experiment to determine if haptics would help in collaborative systems. They found that it improved the system, but
could not find a significant increase in social presence. They explain this partially by saying that the audio communication between the users overshadow the tangible presence. I think the problem was also that the experiment was completely non-social. The task was to cooperate in lifting cubes. It does not require a social interaction in any way. And that might be the problem of this field of research. It is hard to measure the social value of a computer system. I think the experiment in [90] also suffers from the same lack of social interaction, at least from my perspective. This is an extremely rare form of HHI and does not resemble any real life work form even though their focus is on work.

Chang et al. [28] designed a system called ComTouch which is a device that augments remote voice communication with touch, by converting hand pressure into vibrational intensity between users in real-time. They performed two experiments: a general talking scenario and a negotiation scenario. The talking scenario allowed the users to talk freely over an audio link, with an additional tactile channel. The negotiation scenario allowed only the tactile channel. The users had to use only the tactile channel to agree on a ranking of 5 things out of a list of 15 items. The purpose was to find out whether the new vibrotactile mapping could convey information. Their hypothesis was that one-finger vibrotactile communication could show whether there is a relationship between audio and tactile channels. They also wanted to confirm that there is information conveyed in the tactile channel. The results were positive. The participants were able to convey information through the tactile channel and there was a relationship between the audio and tactile channels. For example participants used the tactile channel to emphasize, interrupt and indicate that they wanted to say something.

“These results shed light upon the possible benefits of a tactile communication device in everyday use. A touch-based device can provide an informative and private way to augment existing communication. Touch based communication can allow discreet notification of personal messages without broadcasting an interruption to others.”
2.1 inTouch

One very interesting system is *inTouch [29]*, the predecessor for ComTouch, which I have mentioned. It is a desktop device that employs force-feedback to create the illusion of a shared physical object over distance, enabling simultaneous physical manipulation and interaction. Specifically it consists of two hand-sized objects each with three cylindrical rollers embedded within a base. The rollers on each base are haptically coupled such that each one feels like it is physically linked to its counterpart on the other base. To achieve the tight coupling necessary to allow simultaneous manipulation, inTouch employs bilateral force-feedback technology, with position sensors to monitor the states of the rollers and high precision motors to synchronize those states. Two people separated by distance can then passively feel the other person’s manipulation of the rollers, cooperatively move the “shared” rollers, or fight over the state of the rollers, providing a means for expression through touch.

Brave et al. [29] says that users often described the interaction as fun or playful, and several made enthusiastic requests for the system to “keep in touch with distant family and loved ones”. Many people indicated their belief that inTouch provides a means to be aware of a distant person’s emotional state and sincerity. Some liked the abstract and subtle nature of the communication, while others remarked that the lack of ability to pass concrete information made it uninteresting.
2.1 inTouch

Figure 1: inTouch concept sketch.

Figure 2: Mechanical mockup of inTouch (inTouch-0). Corresponding rollers are connected using flexible drive shafts.
2.2 Hug Shirt

CuteCircuit [30] is an Interaction Design and Product Development Lab, founded in 2004 by Francesca Rosella and Ryan Genz. CuteCircuit is specialized in the development of wearable interfaces for telecommunication, interactive environments and art installations. They have developed the F+R Hugs (Hug Shirt) [31]. It is a shirt that allows to exchange the physical sensation of a hug over distance. Embedded in the shirt there are sensors that feel the strength of the touch, the skin warmth and the heartbeat rate of the sender and actuators that recreate the sensation of touch, warmth and emotion of the hug to the shirt of the distant loved one.

This is very close to my idea of the Squeezeball, and they express many of the thoughts I have around Telehaptics and informal communication (they call it HHI (Human Human Interaction: Interaction between people through technology) as opposed to traditional HCI). They claim that there is a shift away from HCI towards HHI which I also believe is true. Interaction Design is the methodology they focus on.
3 Theory

In this chapter I will go through, and describe, the different research fields and theories which together describe Informal Haptic Computer Supported Human to Human Communication. I will present literature I believe is important, acknowledged and relevant. The literature is referenced by many other researchers, and this gives it scientific strength.

I have landed on two main fields of study for my thesis; informal communication and telehaptics. First I will describe some background research in HCI and CSCW, which I think is important to go through to understand more about informal communication and telehaptics.

Telehaptics is a term used to describe computer generated tactile (tangible or touch) sensations (haptics) over a network, between physically distant human beings, or between a local user and a remote location, using sensors and effectors [32]. I will use the term in this meaning.

Informal communication is a term which is more intuitive, but at the same time harder to define. I discuss this in chapter 3.2.

The rather confusing figure 2 is an attempt to visualize the some fields of study I think are relevant for this thesis and their relative positions. The size of each field is not meant to say anything about its importance or relevancy. Ubiquitous computing for example is not the largest or most important field but it tries to encapsulate all other fields.

In addition I will talk about other subtopics of one or both of the former:

- Ubiquitous computing
- Tangible computing
- Informal/lightweight communication
- Communication
- Haptics
• Telehaptics
• Touch
• Awareness
• Interaction Design
• Common ground theory
• Usability

Illustration 2: Research fields
3.1 Background

3.1.1 HCI

Human-computer interaction (HCI) is the study of interaction between people (users) and computers. It is an interdisciplinary subject, relating computer science with many other fields of study and research. Interaction between users and computers occurs at the user interface, which includes both software and hardware, for example, general purpose computer peripherals, like a mouse and keyboard and large-scale mechanical systems such as aircraft and power plants.

According to ACM SIGCHI¹, there is currently no agreed upon definition of the range of topics which form the area of human-computer interaction. Yet they propose a characterization of the field if to make us able to derive and develop educational materials for it, and at least permit us to get down to the practical work of deciding what is to be taught:

“Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. “[33]

My field of research is placed well within the field of HCI. And like HCI it spans over several fields of study; those already mentioned and:

- psychology
  - human memory
  - human perception
    - sensory system
- sociology
- cognitive science
- human factors / ergonomics

Some much referenced achievements in this area come from Xerox PARC, MIT, Stanford, other American universities and Apple Macintosh in the 60's and 70's. Inventions like Graphical user interfaces (GUI), the mouse, text editors and windows all come from this era. We can call this the computer perspective of HCI. The interfaces are basically the same now as Xerox Alto 1972, Xerox Star 1981, Apple Lisa 1981 and the commercially successful Apple Macintosh from 1984 which all had a GUI, a keyboard and a mouse.[34] Since then the development in this area has focused mostly on improving existing technologies. Like larger, higher resolution screens, replacing the ball in the mouse with a laser and fancy graphical effects.

The Human part of the research seems to be in a more active/innovative state of development, with focus on new ways of using computers and how it affects us. Over the past few years, new highly popular services on the internet has come along, like http://flickr.com/ and http://del.icio.us/ which have not developed any new technology, but uses internet technology that has been available since Netscape introduced JavaScript in
3.1.1 HCI

its browser in 1995. The interface of the PC most people use has not changed, but how we use the PC is constantly changing.

One theory on why this is, can be that the focus of CSCW in the 1980s and early 1990s was on video conferencing [80]. This was because it most resembled face to face communication which was and is regarded as the benchmark for HHC. A lot of this research and commercial attempts tended to give it a bad name. This was perhaps because the technology was not mature enough at that point. Not only was expensive special computers and cameras needed, but most networks at the time provided insufficient bandwidth for video conferencing to be widely used. I think one can say the same about VR. This can explain to some degree why the user interface has not changed very much on the personal computer. Researchers and investors lost faith in these kinds of enhanced user interfaces, and it has not regained its status as an exciting field of study yet.

A basic goal of HCI is to improve the interaction between users and computers by making computers more user-friendly and receptive to the user's needs. Specifically, HCI is concerned with

- methodologies and processes for designing interfaces (i.e., given a task and a class of users, design the best possible interface within given constraints, optimizing for a desired property such as learnability or efficiency of use)
- methods for implementing interfaces (e.g. software toolkits and libraries; efficient algorithms)
- techniques for evaluating and comparing interfaces
- developing new interfaces and interaction techniques
- developing descriptive and predictive models and theories of interaction

A long term goal of HCI is to design systems that minimize the barrier between the human's cognitive model of what they want to accomplish and the computer's understanding of the user's task (see chapter 3.1.3).
Professional practitioners in HCI are usually designers concerned with the practical application of design methodologies to real-world problems. Their work often revolves around designing graphical user-interfaces and web interfaces.

Researchers in HCI are interested in developing new design methodologies, experimenting with new hardware devices, prototyping new software systems, exploring new paradigms for interaction and developing models and theories of interaction.

A pioneer in HCI is Donald A. Norman. In his popular book Psychology of Everyday Things[35] Norman argues that understanding how to operate a novel device has three major dimensions: conceptual models, constraints, and affordances. He basically says that it should be intuitive how a device should be operated. For example, the insertion of a battery in a camera: It should be impossible to insert it the wrong way (constraint), the shape of the battery and the hole should tell you which way is right (affordance).

In a short paper from 1999[36] Norman says: “These three concepts have had a mixed reception”. He discusses the way his ideas have been adopted by web and computer application-designers. He believes many of them have misunderstood the concept of affordance especially. He tries to explain the difference between affordance and perceived affordance. In product design, where one deals with real, physical objects, there can be both real and perceived affordances, and the two sets need not be the same.

In graphical, screen-based interfaces, the designer primarily can control only perceived affordances. The computer system already comes with built-in physical affordances. The computer, with its keyboard, display screen, pointing device, and selection buttons (e.g., mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the screen. Most of this affordance is of little interest for the purpose of the application under design.
This is interesting in several ways, and from my perspective it shows how restricting the traditional computer is. Still the PC is used for or tried to be used for countless types of tasks like text editing, document sharing, communication, multimedia editing, 3D design and so on. There is much research on how to use other interfaces than a PC to do this, but the predominant tool in private and professional life is the PC or a device with basically the same parts as a PC; screen, speakers, keyboard and mouse. This has undoubtedly been a huge success, just ask Bill Gates or Steve Jobs, but as the amount of research on HCI and for example CSCW shows, there are huge challenges too.

In the rest of this chapter I will describe research and technology which by no means dismisses the PC, but also looks beyond it and explores the rest of our world from an ICT perspective.

### 3.1.1.1 Ubiquitous Computing

As I write these chapters I think what I am describing is more and more in the field of ubiquitous computing. The idea that technology should be everywhere and at the same time invisible or transparent, just an extension of our bodies and minds.

Weisser [37]:

“For thirty years most interface design, and most computer design, has been headed down the path of the "dramatic" machine. Its highest ideal is to make a computer so exciting, so wonderful, so interesting, that we never want to be without it. A less-travelled path I call the "invisible"; its highest ideal is to make a computer so embedded, so fitting, so natural, that we use it without even thinking about it.”

Tolmie et al. [38] says:

“Much of the research on Ubiquitous Computing has been dominated by a focus upon the office environment. From the beginning when Mark Weiser articulated the notion of Ubiquitous Computing the office has been the default domain”.

In this article they describe several domestic routines. They point out that these routines are made up of several unremarkable events, that the people take for granted and don’t give much thought. They can be very subtle and sometimes unconscious, and they might
not be able to tell how they got started. However these events are important and they are used in their every day lives to accomplish different tasks. They note that routines are sequences of action that are simultaneously unremarkable and yet central to the realisation of domestic life.

One important point I would like to mention is that it is very difficult to try to design systems that can enhance and augment these routines. Because in the action of introducing a system, you remark upon the routine and the user will be accountable for it. This might be very disruptive and destroy the routine.

Also the article discusses what they call “invisible-in-use”. I get from what they write that systems that try to be ubiquitous does not necessarily have to be invisible, or look like non-technological devices, but rather be systems that people appropriate and use in an unremarkable way. I suggest that a telephone is such a device. It is clearly a technological device, but to most people in our part of the world, it is unremarkable. It is part of our routines. Why it is so I think is a combination of its unquestionable usefulness, its long time in service and its simplicity of use. What is needed by a system to augment daily routines or to bring back forms of actions/interactions that we might have lost in a distributed work or social environment is usefulness and simplicity. I think this is especially important for informal human communication. Systems which are to support this have to be unremarkable.

The system I discuss in chapter 5, might very well, in some scenarios, be in the disruptive area. For example I can see the system used as a substitute for the slap on the back, or the reassuring/comforting touch on the shoulder between colleagues. But that might be what I just described as a disruptive thing in the routine that co-workers might have. If they were encouraged to use the Squeezeball for these interactions they would be held accountable for it. Some people might be uncomfortable in talking about touching their co-workers in social ways, even if they have done so every day for 30 years. Or they might feel it is a fun way to keep in touch and having social moments with co-workers, and even touching them more, because it is not so direct. These questions can not be answered
3.1.1.1 Ubiquitous Computing

until I, or someone else designs and builds the perfect gadget for haptic and tactile communication between people.

3.1.1.2 Usability

In the early days of Internet, a lot of web-pages tried to use metaphors like portals or doors in their design. A web-page could have a picture of a door, or a key hole or even try to look like a house. The idea was that you would enter the portal and walk around in a building, because it was believed that it was a good idea to present the users with familiar objects which they knew how to operate. The lessons learned was that it most often was very confusing, because it did not resemble a house at all, it was just a collection of images and icons.

Harrison & Dourish [3] also see this as a problem in design of collaborative systems:

"We call this appropriate behavioural framing. The implied rationale is that if we design collaborative systems around notions of space which mimic the spatial organisation of the real world, then we can support the emergent patterns of human behaviour and interaction which our everyday actions in the physical world exhibit. In other words, spatially-organised systems will support spatially-managed behaviours."

But they claim that it is not space we should design for, but place, see page 12.

This direct translation of the real world to user interfaces is also something Donald Norman feels he is wrongly seen as an advocate for. I wrote of this in chapter 3.1.1.

This is partly why I have chosen not to design the Squeezeball as an artificial hand, because I think most people would think of it as “creepy” and it is not simple. It would be big, unwieldy and the novelty of having a hand you could shake and squeeze and be squeezed by would wear off and people would not carry it with them. A simple ball that can be squeezed like a Squash ball is also familiar to most people and easy to carry. It could be in different sizes.
Chang et al. [90] propose a phone with integrated vibrators and buttons. I believe this will be very uncomfortable to hold against the ear and I see this as restricting. With my rubber ball you are freer to do other things than just talk. It can be used together with IM, or while reading or surfing the net.

### 3.1.1.3 Interactive Design

“Interaction design is a new design discipline centered on the development of innovative technologies and systems. Interaction Design is informed by other more widely known disciplines, such as: HCI (Human Computer Interaction), ICT (Information Communication Technology), Anthropology, Industrial design, Web development and design, Architecture, Sociology, with experts of each field able to share knowledge with each other, and working together to define each aspect of a product to create a complete and memorable experience.”[39]

John Thackara is an advocate for this methodology. He claims that today, we know how to make amazing things, technically: mobile devices, Internet traffic, processor speeds, and so on, but we do not really know what needs these technologies are supposed to meet. “We’ve created an industrial system that is brilliant on means but pretty hopeless when it comes to ends.”[40] He uses the example of the intelligent refrigerator which will be able to call you on the phone to tell you that you need milk. This idea has been around for years, but I have not seen it in the shops yet. I have never understood why this would be good or how it could be used in real life. Must you scan everything you put in and take out of the refrigerator, or do the groceries need to have RFID tags? And what about leftovers? Must I register them too? Will the corner store in my neighbourhood support this? And does anyone need more noise in the form of annoying computer generated SMS messages or telephone calls? A part of the system is supposedly that you can check on the internet or your phone what is in you refrigerator, so you can plan dinner. But can you trust everyone in your household to carefully register everything in and out? If not you can not trust the information. There seems to be an assumption that people's everyday lives are very structured and rational, which it is not. Another reason why I focus on informal
3.1.1.3 Interactive Design

communication, which is part of social computing or the fact that people are people; social, irrational and extremely complex.

“When it comes to innovation, we are looking down the wrong end of the telescope: away from people, toward technology. “[40]

Thackara goes on to speak of how Interaction design create value. Two of his three points are:

“[...] by designing new ways to connect—with family, friends, lovers, and colleagues. These new ways to connect will be the communication services of tomorrow. People are by nature social creatures, and huge opportunities await companies that find new ways to improve communication and community among people in their everyday lives. Social computing, it has been called. “[40]

“[...] interaction design creates value by allowing us richer and more varied forms of interaction. Interaction design favors all the senses and allows us the power to hear and taste and see and touch and feel. It's about communication that is playful, intuitive, moving, surprising, and fun. This kind of communication has value not found in today's services. “[40]

Participatory design is clearly a part of this line of thinking and CuteCircuit mentions this as part of their approach to design. They involve a large number of people to test and give feedback throughout the process.

3.1.2 Touch

3.1.2.1 Haptic and Tactile

Tactility is something most people know what is. If you touch a surface you can feel if it is rough or smooth. That is the tactile property of an object. A tactile interface is an interface that provides information more specifically for the skin receptors, and thus does not necessarily require movement (motor behaviour). An example of a tactile display is the refreshable Braille display, an electro-mechanical device for displaying Braille characters, usually by means of raising dots through holes in a flat surface. It is used to present text to computer users who are blind and cannot use a normal computer monitor.
3.1.2.1 Haptic and Tactile

Haptic sensing is defined as the use of motor behaviours in combination with touch to identify objects [41]. For example; if you pick up a cup, you can feel its texture and know it is ceramic through its tactility, then you feel its shape and weight through haptics and find out it is a cup. **Haptics** is often used in HCI as the term for applying touch to interfaces. And **telehaptics** is used as a term for computer mediated communication through touch.

3.1.2.2 What is Touch?

"**Tactile or coetaneous sense is defined as a combination of various sensations evoked by stimulating the skin** [42]. **In combination with kinesthesia, tactile feedback is often referred to as haptics** [43] and is crucial for us to interact with our physical environment. **The importance of tactile feedback has been recognized in many fields from virtual reality** [44] **to design of consumer electronics** [45], **and it is natural to extend its applications to mobile computers.**"[46]

The skin is the largest human sensory organ (~1.8 m2 [91]). Every human has a has a relation to touch. We all use touch every second of the day. Just think about what you do when you put on your socks in the morning. You use your vision to locate them, to see if they are inside out and find the end with the opening. But it really is the sense of touch to your fingers and feet which helps you the most in completing the task. Most people could do the whole process blindfolded if they got the sock in their hand or even if they were pointed in the direction of the sock. The fingers find the opening and feels just how much you need to stretch the elastic. Then the foot feels if the sock is too tight or loose, soft or coarse, and when it reaches the end of the sock with the toes. Can you imagine walking, or doing anything without your sense of touch? But you could do it without sound, smell or vision.

An important aspect of touch is cognitive load. **Cognitive load** is how much of a person’s attention is being used up. [47] Touch has a very low cognitive load. This is because large areas of the sensory cortex are devoted to processing stimuli from the skin. Moreover, a
3.1.2.2 What is Touch?

A large amount of the processing occurs in the lower level of the spinal cord, where sensory and motor neuron fibres intersect. That is why we can for example twirl a pen while we write or talk on the phone. This twirling is a complex task. The fingers have to adjust the position in all three dimensions while adjusting the grasping force to avoid dropping it while maintaining a comfortable grip. And the whole time the brain has a good perception of the texture, shape, weight and position.

3.1.2.3 Touch as Communication

"Touch is a powerful means of communication—one that offers an immediacy and intimacy unparalleled by words or images. The firm handshake, an encouraging pat on the back, a comforting hug, all speak to the profound expressiveness of physical contact. In the real world, touch can further serve as a powerful mechanism for reinforcing trust and establishing group-bonding [49,50]. Depending on context however, touch can also be utilized to assert dominance, display power, and even cause harm." [51]

Touch as a tool for communication is of course not a new thing at all. I guess that's how the first amoeba communicated in the primordial soup. And humans have always used touch as an important form of communication. Think about how parents communicate with newborns and the famous story of Helen Keller [52] gives you an idea of the richness and possibilities of the medium. Humans are able to distinguish a wide range of tactile wave shapes. Gault in 1924 [53] converted speech into vibration and found that trained subjects were able to distinguish one out of 10 short sentences with 75% accuracy." [54].

We use touch to communicate with each other. Touch is extremely important for children, and is a huge part of family life. Adults also use touch to communicate with friends, family, colleagues and even strangers. The importance of communication through touch between lovers does not need any elaboration. Inappropriate touch is often received worse than inappropriate statements. For example if a stranger on the bus touches you in an inappropriate manner, you will probably feel it is a more negative experience than if the same person says something inappropriate to you. This is related to our individual intimate, personal, social and public zones [55].
3.1.2.3 Touch as Communication

Very often when I try to explain to people what I write about, their first thought is often “SEX!”. This is understandable because touch is a large part of sexual conduct and also because the sex industry are often quick to adopt new technologies (colour printing, video, DVD’s with multiple camera angles, internet, MMS), and the news media loves to write about anything concerning sex. Ever since Virtual Reality became a concept, the possibilities for it as a sex tool have been described. And there exists some crude systems, but the technology is far from being able to give people any sense of sexual interaction that even resembles the real thing.

3.1.2.4 The Other Senses

The four basic channels for communication we have are:

1. Vision
2. Sound
3. Smell
4. Touch

Technology for communication through vision and sound is plentiful and diverse, like the telephone, letters and SMS. It is still in development and constantly changing, and I think it is safe to say that these technologies are useful and important in our society.

Systems integrating smell is not very common, but a quick search on internet shows there are research going on in this field. Just how useful this will prove to be is impossible to say, but there’s no doubt that smell is important to us. I will not not investigate this further in this thesis.

Touch is already implemented in several systems, and have qualities that the three others don’t. All four channels have unique qualities that makes them ideal for different purposes. And together they make us, and other animals, function very well in our environments.

The following is a short discussion, illustrating the differences and abilities of our senses, and especially how useful the sense of touch is:
3.1.2.4 The Other Senses

You can’t drive a car while watching TV, but radio works fine. This does not mean that visual technologies are excluded in a car. Speedometers, electronic maps and high-tech systems to help drivers see in the dark or fog are good examples. There are several audible devices also. The clicking when the driver turns on the signalling lights, the warnings if she forgot the seatbelt or if a door is open are examples of that. There are several tactile devices in a car as well. The steering wheel tells the driver through the resistance in the wheel if the wheels are turning left, right or straight ahead. The break pedal tells how hard the driver is braking through the pressure on the foot. These are deliberately implemented technologies, but all kinds of impressions in the car will tell you if the car is accelerating, decelerating, skidding, turning, overheating, if the clutch is burning (this smells bad), is expensive, cheap, new, old and so on. An endless amount of information. If we were able to remove all but one of our channels, I'm sure we could get most of the information. Maybe except smell. I guess you could smell if it was new or old, but not the speed...

3.1.2.5 Tangible Computing

Traditionally research into force-feedback (haptic) interfaces falls into three main categories [90]:

1. The first is simulation, where the goal is to enhance the sense of realism in virtual worlds (included in this category are VR applications such as surgery training and gaming) [56].

2. The second is scientific visualization, where force output serves as an additional channel for exploring complex data sets.

3. Finally, a growing body of literature has begun to investigate the potential for force-feedback to improve the efficiency of conventional GUI interactions [57, 58, 59].

All these researches focuses on a single user interacting with hardware. I believe the tactile and the haptic dimension has a great value for mediated person-to-person interaction. During my research I have found that there is an increasing number of researches in this field. This underlines that it is a natural next step in computer mediated personal communication recognised by several researches all over the world.
Luk et al. [60] suggest that one reason why haptics have not been implemented in communication systems is because relatively few instances of integrated, rich haptic feedback systems exist today. That is, the technology is not mature yet.

3.1.3 CSCW

The term computer supported cooperative work (CSCW) was first coined by Greif and Cashman in 1984, at a workshop attended by individuals interested in using technology to support people in their work [61]. According to Carstensen and Schmidt (2002), CSCW addresses "how collaborative activities and their coordination can be supported by means of computer systems." On the one hand, many authors consider that CSCW and groupware are synonyms. Ellis [62] defines groupware as "computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment." On the other hand, different authors claim that while groupware refers to real computer-based systems, CSCW focuses on the study of tools and techniques of groupware as well as their psychological, social, and organizational effects. The definition of Wilson (1991) expresses the difference between these two concepts:

\[
\text{CSCW is a generic term, which combines the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software services and techniques.}
\]

A lot of confusion in the field of CSCW raises from the different interpretations of the terms collaboration and cooperation. Once again, many authors simply consider both terms as synonyms, while others [63] draw a distinction between them:

\[
\text{Cooperation and collaboration do not differ in terms of whether or not the task is distributed, but by virtue of the way in which it is divided; in cooperation the task is split (hierarchically) into independent subtasks; in collaboration cognitive processes may be (heterarchically) divided into intertwined layers. In cooperation, coordination is only required when assembling partial results, while collaboration is «...a coordinated,}
\]
The concept of cooperation is often used in relation to the concepts of coordination and communication. First, the splitting of a cooperative task into independent subtasks naturally leads to a need for coordination. In this context, coordination can be defined as "the management of dependencies between activities and the support of (inter) dependencies among actors" [64]. Then, communication can be defined as a process by which information is exchanged between individuals through a common system of symbols, signs, or behaviours. According to Brehmer [65],

"communication is the cement of the organization, and the greater the need for coordination and cooperation, the greater the necessity for communication."

This is obvious; if we want to accomplish something together, we have to communicate.

Ellis et al. [92] states that:

"Successful technological augmentation of a task or process depends upon a delicate balance between good social processes and procedures with appropriately structured technology."

Nardi [2] shows this, and I write more on that later. Good social processes are important, privately and at work.

The whole field of CSCW is focused on work and individuals in an organisation. Of course all research on CSCW acknowledges that social aspects are important, and much research has shown that by supporting and enriching social functions, the organisation benefits.

3.1.3.1 Communication

I think everyone agrees that communication with friends, family, colleagues, strangers and even animals and objects is what our lives are all about.
“No man is an island, entire of itself; every man is a piece of the continent, a part of the main. If a clod be washed away by the sea, Europe is the less, as well as if promontory were, as well as if a manor of thy friend's or of thine own were. Any man's death diminishes me, because I am involved in mankind; and therefore never send to know for whom the bell tolls; it tolls for thee.” [66].

Donne suggests that no man can exist by himself. He states that we are all interconnected, and someone else's loss is a loss of our own. In the same sense, someone else's death is a death of our own. Each time the bell rings, mankind loses. The idea of a person completely isolated from everyone and everything is completely absurd. We all communicate with each other, animals, plants, places and things in many ways and have done so since (and before) the human race evolved.

Communication is everything and all we are. Without it, we would be nothing. Most of our communication is informal and is what shapes us into what we become as we grow up and grow older (our socialisation).

### 3.1.3.1.1 Communication Technology

There has always been communication technology. Drums has to be one of the earliest. Today we have several more sophisticated systems. For example Mobile telephones, email and IM. I will not limit my discussion of CT to technical devices, we have to consider face to face conversation as a form of CT for example in order to compare them. All forms of communication technology have different abilities and are used for different things.

In many parts of the world, where we have access to modern technology, the ways we communicate change rapidly. Human communication has always evolved through evolution of languages and changing cultures, but now we get new communication media
3.1.3.1.1 Communication Technology

rapidly. These media not only enable us to communicate in situations where this would be impossible without them, but it also has an impact on how and what we communicate and how we live. Nardi et al. [2] describes how IM was used in several different ways that would be impossible through other traditional forms of communication. Like what they call “plausible deniability about one’s presence”, where you can receive a request but choose to ignore it without people taking offence. In face to face communication this would be considered extremely rude. Also this way of trying to establish a connection was considered less intrusive than calling on the telephone. If someone calls you, you have to ignore the ringing, or turn the sound off, this is more disruptive than getting a small piece of text showing up on your computer screen for a few seconds.

What Nardi points out is very important and is at the heart of all research in the fields I describe. Modern technology has enabled us to communicate over distances of time, space and context but at the same time this might have pushed us farther apart and removed some of the communication channels or the richness of the communication. A video conference is something completely different than a face to face conversation, which is often regarded as the benchmark of communication media. And this gap is what especially CSCW research is trying to fill. Research in HCI, product design, system design and the other fields I talk about in this chapter are all concerned with this. And this is where I also try to make a contribution by focusing on informal communication and haptic communication. My focus is not on how this can make people more productive or how to replace current communication media, but just to explore a field that has been lacking in traditional research of this type, and see what I find.

3.1.3.1.2 Face to Face Communication

If you talk to someone face to face, there is a lot more than the words in the form of sound that reaches your ear that is the communication between you. This is what I call a rich form of communication, because of all the nuances and all the different ways you can express yourself. If you could measure the richness of this form of communication I think this type would be close to infinitely rich. You both emit thousands of signals. The complexion of your skin, an unending stream of complex facial expressions, body heat,
3.1.3.1.2 Face to Face Communication

smell, gestures and so on, all combine to form the communication between you. In addition the context you are in defines how these signals are interpreted.

I am not saying this is the best form of communication, I do not think one can rank them. I do not want to create a system for simulating it. But I claim that face to face communication is important because of the richness of it. And as I have said it is often regarded as the benchmark communication media, a reference for all other.

With all our forms of communication technology, new and old, we can communicate in many different ways and different media are used for different things and they all add to the sum of richness of our communication. A natural thing to add to all this is touch.

3.1.3.2 Groupware

Ellis et al. [92] define groupware as:

“computer based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment.”

As I have mentioned groupware and CSCW technology is often used as synonyms. Ellis et al. suggest a broader view of groupware, specifically that it does not necessarily support cooperation.

The following sub chapters describe and discuss some qualities of groupware. They are also put in the perspective of telehaptics and/or informal communication.
3.1.3.2.1 Time and Place

### Table 1: Time and place

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<th>Different times</th>
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<tbody>
<tr>
<td><strong>Same place</strong></td>
<td>face to face interaction</td>
<td>Asynchronous interaction</td>
</tr>
<tr>
<td><strong>Different place</strong></td>
<td>Synchronous distributed interaction</td>
<td>Asynchronous distributed interaction</td>
</tr>
</tbody>
</table>

Typical examples of groupware that corresponds to the upper left corner are: meeting room technology. Upper right: A physical bulletin board or a sign. Lower left: Telephone and IM. Lower right: email and traditional mail.

Many systems have qualities that fit into more than one quadrant. IM for example can fit in all four. Two people can sit in the same room and watch each other and the computer screens while they send each other messages. A could sit in the same room as B and send a message to B, but B will not read it until later. Then you have the intended use for IM, where two users sit in different places and send each other messages in real-time. Lastly, A and B are in different cities and A sends a message, but B does not read it until later.

A telehaptic system, like the Squeezeball, could fit into all four quadrants. It functions distributed and synchronously, and a replay of haptic interactions would support asynchronicity.

3.1.3.2.2 Awareness

According to Dourish and Bellotti [67], awareness is an understanding of the activities of others, which provides a context for your own activity. Nardi [89] described what they called awareness moments, when co-workers could see others signing on to the IM system. This gave them a sense of social connection to the others, they were not the only ones to do a little work on the weekend. A tool for cooperation or just communication benefits from supporting awareness. For example, if you see someone in an office, you
3.1.3.2.2 Awareness

can decide if it is appropriate to approach the person with a question, but if you call by
telephone, you do not know what context they are in, you could call at an inconvenient
time.

I propose that a telehaptic system would increase the sense of awareness and social
connection. If someone interacts with me telehaptically and synchronously I would have
an understanding of the activities of the other person and feel a sense of social
connection.

3.1.3.2.3 Social Presence and Media Richness

Witmer and Singer [68] define presence as the subjective experience of being in one
place or environment, even when one is physically situated in another.

Social presence theory [69] address how successfully media convey a sense of the
participants being physically present, using face to face communication as the standard
for the assessment. Social presence depends not only on the words people speak but
also on verbal and non-verbal cues, body language, and context [70,71]. Reduced social
cues (i.e., gestures, body language, facial expression, appearance and so on) are caused
by low bandwidth, which affects communication [72].

Media richness theory is similar to social presence but takes a media perspective [73]. It
describes the media's capacity for immediate feedback – how well it conveys cues, and
how many and in which ways the senses are involved [73].

3.1.3.2.3.1 Reduced Cues

Social presence fundamentally affects how participants sense emotion, intimacy, and
immediacy [71]. Early studies reported fewer personal messages with lower
socioemotional content [74] that lacked cues about social context [75]. The "cues-filtered-
out hypothesis" was used to explain these observations [76]. Bandwidth was insufficient to
carry all the communication signals needed for communicating social, emotional, and
3.1.3.2.3.1 Reduced Cues

contextual content. In text-only systems, for example, both task information and social information are carried in the same single verbal/linguistic channel, which, though adequate for most task information, cannot transmit non-verbal information such as body language, voice tone, and so on [77].

The consequences of filtering out social, emotional and contextual information vary depending on their importance to the communication task. There are three main ways that this affects communication. First, signals needed to understand conversation may be missing; for example, when face to face, speakers can check frequently with each other to ensure they understand the conversation as it progresses. This is the aforementioned important concept known as common ground, which will be discussed in detail in the next section. Non-verbal signals such as a nod of the head, a quizzical look, or a wave of the hand can say a lot. Second, conversations proceed by speakers taking turns: various signals such as pauses in speech or a gaze are used to cue the next speaker to take his or her turn. Third, seeing and hearing the speaker enables the listener to infer information regarding the context of the conversation and the speaker's feelings. Olson & Olson [78] succinctly argue that differences in “local physical contexts, time zones, culture, and language all persist in spite of the use of distance technologies,” and that these differences take a toll on communication. Furthermore speakers do not get evidence of each other's emotional states. They cannot see if the person is having a bad day or is tired, so they do not know whether or how to temper their comments. Consequently, “distance matters” [78].

In addition, reduced social cues can encourage unusual behaviour that would not occur if people could see each other. Some people feel comfortable behaving aggressively on-line because they are hidden behind a veil of anonymity. The way participants form impressions of each other and how much personal information they are prepared to disclose are also influenced. In addition, with fewer social cues to monitor, some people find it easier, even fun, to assume different persona or even switch gender. These effects are interrelated in complex ways, therefore separating them is not straightforward.
3.1.3.2.3.1 Reduced Cues

I have now described some research on Awareness, social presence and media richness. There has not been any mention of haptics in this chapter but I think this is a natural step to make. As I said the whole discussion uses face to face as the benchmark reference. Touch is often overlooked as a channel in face to face interaction. This might be because it is not since the last 10 years perhaps that there exists commercial and affordable systems available with the bandwidth necessary to convey haptic communication.

Touch can add to communication richness to a great degree. It can give immediate feedback, convey cues and it is a sense in itself (and an important one, see chapter 3.1.2). So it fulfills the criteria of Daft & Lengel [73], but how well is of course up to the design of the system.

Regarding reduced social cues; This is what has made much of the communication forms on the internet so popular. We are currently experiencing a new wave of this through what is now called Blogging. The anonymity and the reduced social cues together makes for example IRC (Internet Relay Chat), discussion groups, dating services so popular among many people. I am curious what touch could add to this. Touching, or being touched by someone anonymously is interesting, but it does seem more intimate and maybe therefore a bit repulsive to some and very appealing to others. I think this illustrates how powerful touch is.

3.1.3.2.4 Common Ground

Common ground theory can be used as a framework for determining how two people or a small group validate that they understand each other [80]. It focuses on how communication process and content are coordinated. Much of this coordination depends upon social presence or appropriate ways of compensating for its absence.

“It takes two people working together to play a duet, shake hands, play chess, waltz, teach or make love. To succeed, the two of them have to coordinate both the content and the process of what they are doing ... They cannot even begin to coordinate on content without assuming a vast amount of shared information or common ground – that is,
Common ground is established by a process of grounding. Grounding is different in face to face conversations than in a phone call, and it is different in the courtroom than at a friendly meeting over a beer at a pub. Grounding is influenced both by the communication medium and the communication task.

Grounding leads to a mutual belief between participants that they share a common understanding. Most conversations require a series of twists and turns to convince the speaker that she has been heard and understood. Verifying how much attention the partner is paying to her comments enables the speaker to judge whether there is a shared understanding. In face to face conversations one can use gazes, nods and facial expressions in addition to utterances to indicate attention. Checking, repeating, and rephrasing comments encourage common ground.

Establishing common ground happens through mostly unconscious processes. This is learned through our socialisation. However, if we try a new medium we have to learn it again, because you can not use the same grounding techniques in every media, because of the different restrictions and abilities they possess.

The following is a list of opportunities offered by different media:

- Co-presence: A and B share the same physical environment, as in face to face conversations.
- Visibility: A and B are visible to each other, as in face to face communication and video conferencing.
- Audibility: A and B communicate by speaking, which can be very effective for conveying factual information.
Cotemporality: B receives at roughly the same Lima as A presents, so the message is received immediately.

Simultaneity: A and B can send and receive at once and simultaneously.

Sequentiality: A's and B's turns cannot get out of sequence as in asynchronous communication.

Reviewability: B can review A's message.

Revisability: A can revise messages for B.

I would like to add Touchability to the list.

Touchability. A can touch B.

The following table describes the communication opportunities offered by different media/systems. It is adapted from Clark & Brennan [81], and Preece [80] p.162, I have added telehaptics and IM and removed a couple of non-relevant systems.

<table>
<thead>
<tr>
<th>Medium</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>face to face</td>
<td>Co-presence, visibility, audibility, cotemporality,</td>
</tr>
<tr>
<td></td>
<td>simultaneity, sequentiality, touchability</td>
</tr>
<tr>
<td>Telephone</td>
<td>Audibility, cotemporality, simultaneity,</td>
</tr>
<tr>
<td></td>
<td>sequentiality</td>
</tr>
<tr>
<td>Video teleconference</td>
<td>Audibility, visibility, cotemporality, simultaneity,</td>
</tr>
<tr>
<td></td>
<td>sequentiality (in some systems)</td>
</tr>
<tr>
<td>Answering machine</td>
<td>Audibility, reviewability</td>
</tr>
<tr>
<td>Electronic mail</td>
<td>Reviewability, revisability</td>
</tr>
<tr>
<td>Letters</td>
<td>Reviewability, revisability</td>
</tr>
<tr>
<td>Bulletin boards messages</td>
<td>Reviewability, revisability, sequentiality</td>
</tr>
<tr>
<td>Chats</td>
<td>Cotemporality, simultaneity</td>
</tr>
<tr>
<td>Instant Messaging</td>
<td>Cotemporality, simultaneity, reviewability</td>
</tr>
<tr>
<td>Telehaptics</td>
<td>Cotemporality, simultaneity, reviewability(the</td>
</tr>
<tr>
<td></td>
<td>Squeezeball logs touches, and can replay them),</td>
</tr>
<tr>
<td></td>
<td>touchability</td>
</tr>
</tbody>
</table>

Table 2: Media and common ground

The different media have different abilities and restrictions. And as I will describe here and later in the thesis, they have proved to be very useful for different tasks. face to face have
3.1.3.2.4 Common Ground

the most opportunities, but you can't review or think to long about what you want to respond, and if you do not respond at all, you will be considered extremely rude. Using IM, you can choose not to respond because the sender of a request is unaware of your context so she might assume you are not there or busy. With letters and email you can review, revise and really think through what you want to say.

You can combine these media too. IM and video are combined in Microsoft MSN, and during face to face communication it is not unusual to show each other text and an email might well contain video, images and sound. Combining telehaptics with other forms of media is very interesting and I think it can add much to the grounding process and in conveying social presence. For example, it could help define the mood of a written conversation, and could also be a means for expressing feelings and empathy which sometimes fails when using only text.

3.2 Informal Communication

In this chapter I will discuss what informal communication is and describe and discuss some empirical studies which focus on informal communication.

3.2.1 What is Informal Communication?

I use the term in a wide sense. Kraut [82] showed it to be brief, unplanned, and frequent interactions between people. Whittaker [93] talks about lightweight communication, and says that it is brief, informal, unplanned and intermittent. And Nardi [89] calls it outeraction, by this they mean processes outside of information exchange in which people reach out to others in social rather than informational ways. All these definitions fit into what I want to explore.

An example of it could be: You and a partner have written a paper together. Your partner works in a different country. He has sent the paper to a colleague of yours who works at the same place as you, and asked if she could give some comments. You meet the
3.2.1 What is Informal Communication?

colleague on your way to get coffee, and you say: “Hi Diane! Have you had a chance to look at the paper my partner sent you? You don't have to read the whole thing, just skim through and tell us what you think”. And she responds: “Oh! Was that your paper? I didn't see your name on it, so I didn't set it as a priority. Sure, I'll look at it.”. This was a brief, unplanned meeting which clarified, elaborated and put misunderstandings right. I call this informal communication.

“Informal face to face (FTF) communication has been shown to serve many important functions in organizations, including complex coordination, problem solving, and social learning [9, 10, 11, 21]. Early attempts to build tools to support informal communication focused on audio and video environments [1, 4, 7, 19]. However, these attempts have not been widely adopted for several reasons, including the lack of support for core user tasks, cost, privacy concerns, and implementation difficulties [1, 9, 10, 20]. “[89]

Whittaker [83] says:

“Communication theories and technology have tended to focus on extended, formal meetings and have neglected a prevalent and vital form of workplace communication—namely, lightweight communication. Unlike formal, extended meetings, lightweight interaction is brief, informal, unplanned, and intermittent.”

Informal communication supports a number of different functions: the execution of work-related tasks; co-ordination of group activity; transmission of office culture and social functions such as team building [82,84]. Its importance is shown by research into scientific collaboration demonstrating that physical distance is a strong predictor of whether scientists will co-publish, because people who are physically collocated are more likely to communicate frequently and informally. Questionnaire studies also suggest that physical proximity supports frequent opportunistic conversations which are vital to the planning and definitional phases of projects [85]. Other questionnaire studies support the effects of proximity and hence informal communications on social and cultural knowledge: Researchers are more likely to be familiar with, and to respect the work of colleagues who sit close to them [19].
3.2.1 What is Informal Communication?

Whittaker et al. [86] documents that informal communications account for 31% of office activity. Kraut, C et al.[93] shows that removing such interactions significantly decreases effective collaboration.

Nardi[89], Whittaker [93] and Kraut [87] all write about how important informal communication is. At the same time their research is restricted to work in organizations. I think research in this area would benefit from taking into account private relations outside of the workplace. Of course research into organizational effectiveness is important and it delivers knowledge that can be used in all areas of life, but as Whittaker says; research has traditionally focused too much upon formal work patterns. Nardi, Kraut and Whittaker has shown that this does not give a correct view of reality, we are social beings with humor, dreams and irrational behaviour which has a profound impact on how we work, how an organization works and everything else on this earth. Additionally the clear border between home and office is not so clear any more. More people work at home and peoples professional lives and personal lives are more interconnected now than they used to be 30-50 years ago.

For example, when teenagers send what I might perceive as inane messages to each other through SMS, I might question the value of it and think that they are cynically exploited by the telecom business and that it does not contribute to society, it disturbs the learning environment in a class room and that the technology is no more than a toy. But this is a part of growing up and always has been, it's just the media that has changed and given children, teenagers and everyone else a new way of communicating which fits well into our current way of living.

I believe this description of informal communication suggests that supporting it in communication systems can be very useful, professionally and socially.
3.2.1.1 IM and Informality

Nardi et al. [88] explore a concept they call outeraction. They show how important negotiating availability, sustaining social connections, switching media, and retaining context in workplace conversation is and that this suggests areas of expansion for communication and media theories. Especially how they described the informal social connections is what partially what inspired me to start this project. In the article they studied the use of IM. They showed that IM was often used as a social tool and it resulted in what they call awareness moments. These moments produced a certain feeling in people rather than accomplishing information exchange. People felt a sense of connection to others even if they didn't contact them, but just monitored their status in the IM tool. The IM tool was also used a lot for informal greetings, like "hello" or "good morning". They noted that it would be considered lunacy to deliver a “Good morning” message in email, but that people appreciated a quick IM greeting.

Isaacs et al. [89] went through a over 21,000 of IM conversations by 437 users and found that in contrast to earlier beliefs about the use of IM, where it has been emphasized that it is mostly used for rapid single-purpose exchanges, scheduling, and socializing. Their analysis suggests that these reports have over-emphasized those functions and greatly under-reported its use for extended work discussions, at least among workplace users. They also found that workplace IMs only occasionally turned to personal matters, and few were exclusively personal. This means that IM is used more professionally than earlier research has assumed. At the same time they say that IM has become of great interest to the CSCW community because it is a tool that successfully supports informal communication. And they suggest that the characteristics of heavy IM use – multiple, brief, intermittent interactions per day with minimal closings – mirror the nature of impromptu pair-wise interactions in other media [90, 91, 86]. This finding reinforces the notion that these are key characteristics of lightweight, unplanned interactions. Other tools intended to support it must be designed to support those characteristics.

Overall, these results help explain why IM is often used for informal workplace communication, and why it is sometimes preferred to face to face communication [2]. IM
3.2.1.1 IM and Informality

supports a broad range of uses: not only rapid, single-purpose interactions, but also complex work activities.

Lovejoy & Grudin [92], discuss a possibility of how IM can lose its informal nature because it becomes more normal to log conversations. They describe how email was used as an informal communication channel in the beginning, but that it gradually gained a position as a formal tool. In the early days of emailing, it was not normal to save messages because storage was limited, and so emails were mostly informal. But as disc sizes increased and email was saved, senders could be held accountable for earlier messages, which meant that you had to be more careful about what you wrote, and so emails began to be more formal. They have observed in a workplace that the people there felt that IM had lost its informal abilities when they discovered that the new version of their software could log conversations.

This shows how support for informality in communications systems is important, and what can happen if it is disturbed.

3.2.1.2 How to Support Distributed Informal Communication

Kraut et al.[93] have released several studies on trying to create video telephony tools to support this type of communication. It has proven difficult. Theirs, and others research show that it is tricky, because of the intrusive and “Big brother” feel of having cameras focused on you and screens with other faces around you all the time.

Whittaker et al.[93] analyzed naturalistic data from a study of workplace communication and derived five design criteria for lightweight interaction systems:

(a) Conversational threading: Participants are engaged in multiple intermittent communications tasks, often with different individuals. The system must therefore keep track of interactions, storing elements of the same conversation together so that they can rapidly be accessed as a unit, allowing participants to check the status of a given conversation.
3.2.1.2 How to Support Distributed Informal Communication

(b) **One-way drop**: The system should support the ability to leave a brief asynchronous message, given the fact that attempts to achieve opportunistic connections frequently fail, and a valuable-information exchange can often take place without synchronous communications.

(c) **Quick connection**: Given the brevity of lightweight interaction, the system should support rapid flexible communications, and participants should be able to quickly connect with others. **Context preservation and regeneration**: Given the intermittent but repeated nature of lightweight interaction, where there are often long delays between elements of the same conversation, the system should support methods for straightforwardly accessing prior parts of ongoing conversations, including the materials or artefacts that are involved in that interaction.

(d) **Shared objects**: The system should support real-time shared objects as props and conversational resources, both because of the frequency with which documents feature in lightweight interaction and their supporting role in mediating conversation.

Whittaker created a table for evaluating current communications technologies for lightweight-interaction features. I have expanded it to include IM, SMS and the Squeezeball.
How to Support Distributed Informal Communication

As this table shows IM supports these criteria well. Its ability to quickly connect when you see the other person log on (opportunistic) and the one way drop with plausible deniability

<table>
<thead>
<tr>
<th>Type</th>
<th>Telephone VoiceMail</th>
<th>Email</th>
<th>WorkMail</th>
<th>Pager</th>
<th>Media Spaces</th>
<th>Videoconference</th>
<th>Workstation</th>
<th>Shared Folder</th>
<th>Instant Messaging</th>
<th>SMS</th>
<th>SqueezeBall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Not supported in most systems</td>
<td>Supported in most systems</td>
<td>No</td>
<td>Supported in most systems</td>
<td>No</td>
<td>Supported in most systems</td>
<td>No</td>
</tr>
<tr>
<td>Synchronous</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>One Way</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 3: Evaluating Current Communications Technologies for Lightweight-Interaction Features.
(see chapter 3.2) as a response. In Microsoft Messenger, a popular IM tool, you can log all your conversations and it supports some simple real-time shared objects like Whiteboard for drawing and writing, and other application sharing.

The Squeezeball on the other hand, only support some of the criteria. With its limited form of information transmission ability (at least without training of the user), the Squeezeball does not support specific work related information exchange, not in a traditional groupware sense at least. While IM supports both professional information exchange, it also supports social interaction. And as Nardi (see chapter 3.2) showed this functions as oil and glue (in a positive way) in an organisation. The Squeezeball supports social interaction maybe in a more limited, perhaps more intimate and at least different way. But it might not support work or function as a traditional groupware. It adds something to the mix, and I think it adds support to Informal Communication, as is the idea.

The other criteria are supported, even though in different ways than the other types of communication technologies. The Real-time Shared Object, is the ball itself. It might give a greater sense of sharing, since it is tangible. You could replay squeezes in a conversation to support Context preservation and regeneration. But it could perhaps not regenerate or display the materials or artifacts that were involved in that interaction. The quick drop could be supported by asynchronous squeezes which the user receives at an appropriate time.

3.3 Summing up

My impression is that to support informal communication we need to exploit all forms of communication media, and let them support each other. Video can be formal and informal. It supports information exchange and creating and supporting social bonds when the connection is already in place, but is not good for outeraction. SMS and IM are great for outeraction and certain forms of information exchange, while email is somewhere in between. Email is non intrusive and can be both formal and non formal.
3.3 Summing up

Informal social interaction is very important to people. If that isn't working in a group or organization, it is dysfunctional. That is why I believe we should take things one step further and build upon what for instance IM has shown; that informal communication, social interaction and a sense of awareness of other people is important and should be incorporated in any type of CSCW.

The ideas Thackara express of focusing on people, not technology and supporting new ways of connecting people fits perfectly with what I suspected when I started this thesis after the inspiration from Nardi [2] and Chang [28]. My focus is on the social and informal interactions like Nardi [2] described, and how to support them in a distributed environment with technology. The last 10-15 years the focus has been on designing systems which enables us to be mobile and distributed, but maybe now it is time to focus on the qualities of such systems and how they impact us socially and personally. I realize that creating an artificial device to replace physical contact is a contradiction to this, but still the focus on these things can help us design better and more humane systems.
4 Identity and Belonging in Mobile Work: I-TEMA

In this chapter I will describe the research project, I-TEMA. I will describe its structure, goal and what I have contributed to it.

4.1 Project Description

Organizations face a need for increased knowledge about mobile and distributed cooperation, including the possibilities and limits of electronic media.

Studio Apertura (social research centre), Telenor Research & Development and the University in Oslo are partners of the research project I-TEMA.

I-TEMA focuses on mobile teams' ability to develop and maintain collective identity and belonging - and how different kinds of groupware supports the processes. The research will point at best practice and suggest alternative solutions.

Main subjects:

- Collective identity, social capital and network in distributed organizations and work groups
- Symbolic meaning of place and materiality for organizational identity
- Technical solutions to increase understanding of identity and belonging in distributed work groups
- Group processes and cooperation in interdisciplinary and distributed organizations

I-TEMA is in charge of sub-theme no 9 at the 22nd EGOS Colloquium 2006 in Bergen, Norway. The I-TEMA project is a research project aimed at studying behaviour, coordination and interaction as well as symbols in mobile and distributed workgroups from individual and organisational perspectives. I-tema is a Norwegian abbreviation for Identity, Belonging and organisational solutions in a Mobile working life. The project emerges from a motive to increase knowledge about the terms for cooperation in mobile and distributed
workgroups, and to assess the communication media's possibilities and restrictions in this context. There exists a clear need for increased knowledge – both theoretical and empirical – to understand the implications of an increased degree of such work methods. Mobile work is especially interesting because a large part of the work force are working mobile and since it so far is done very little research in this field. There is also a need for increased knowledge about what kind of possibilities and restrictions organisations meets when trying to accomplish intensive cooperation over distance. The main focus of the project is to study how distributed and/or mobile workgroups maintain a shared identity and group belonging, and how the media are used to support these processes. More specifically: To explore identity within distributed groups, as well as the interaction between the company's presentation of itself and the employees' self representation. This demands that the project also analyses organizational challenges in the form of cultural, structural and relational characteristics, connected to distributed and mobile work. The project will perform a series of empirical studies and experiments in Norwegian companies, integrated through a common theoretical framework. The approach will be descriptive, interpreting and prescriptive. In other words; they will describe changes, try to understand the logic behind new work methods, try out new communication solutions and suggest new solutions or changes in work methods. Another goal of the project is to integrate research fields that has traditionally worked more or less autonomously with these types of challenges, including: IS, CSCW, communication research and organisational research.

4.2 Main Goals

The projects main goal is to study behaviour, coordination and interaction as well as symbolism in mobile and distributed workgroups, within individual and organisational perspectives. Through this the project will develop knowledge about how mobile workgroups establishes and maintains a common identity and group belonging, and how communication media are used to support these processes. From this knowledge there will be developed suggestions for methods and solutions which can support group formation an identity developing processes.

4.3 Organisation

The project consists of people from:
4.3 Organisation

- The Norwegian University of Science and Technology (NTNU), Studio Apertura
- Telenor R&D
- University of Oslo, Institute of Informatics

These organisations represent expertise in different fields of research. Telenor R&D are experts on user-focused studies of communication technology, Apertura are experts on organisational development and University of Oslo's Institute of Informatics are experts on use of information technology.

4.3.1 People

The project leader is professor Per Morten Schiefloe at Studio Apertura and managing director is Tom Erik Julsrud from Telenor R&D. There are two PhD scholarships and several master students from NTNU and UiO in addition to employees of the respective research institutions who are participants in the common project work.

4.3.2 Work

The I-tema group is a distributed community which builds a common knowledge within the defined sub-projects by:

- Practical cooperation: Within every sub-project there will be participants from the three partners in the project.
- Symposia: There will be held a series of workshops where people will present and discuss preliminary results.
- Common work: A collection of scientific papers will be created. Publications will happen inter-institutionally.
- Conferences: By request from the Norwegian research council (Forskningsrådet), there will be a common conference for participants from all projects that are financed by the KIM-program.

The empirical work will happen in Norwegian organisations in the fields of oil, telecommunications and insurance. Namely: Shell, If, Statoil, Telenor and Accenture.
4.3.3 Economy and Timeframe

4.3.3 Economy and Timeframe

The economical basis for the project is provided by the Norwegian research council (Forskningsrådet) through the research programme; Communication, ICT and Media(KIM). There are totally 6 million NKR distributed throughout the project period 01.08.2003 to 20.12.2006. The costs of the project are related to conference attendance, PhD scholarships and travel in connection with empirical studies.

4.4 My Participation

I have been a part of this project since I was enrolled as a master student and I have attended meetings at Dragvoll Gård in Trondheim, at Telenor R&D at Fornebu, Akershus and at video-teleconferences between these locations. These meetings have been very useful to me, as I received valuable feedback especially in the early drafts of my thesis.

I believe my research is very relevant to the project and vice-versa. As professor Per Morten Schiefloe noted in a tone filled with understatement at one of my presentations: “There is little controversy around the idea that socialisation is the foundation of identity development.” And that is what my thesis is about; in the form of informal communication and touch as communication which are maybe the most important forms of socialisation. So I believe my role in the project is what was the intention, to look at technologies which help develop mobile workgroups and to increase the sense of belonging and group identity.
5 Scenarios

To create a device for haptic communication has proven unrealistic with regards to time, technical knowledge and economical resources, for this project. So instead I have created some scenarios as a way to illustrate possible technological solutions and uses for computer mediated haptic communication. Central in these scenarios is a device I have called the Squeezeball, which I will describe later in this chapter.

My idea is not to introduce something completely new, but simply to enhance the already existing systems. The great advantage is that all the tools like communication channels, technology and even people's familiarity with the notion of computer-mediated touch is there. Most people have vibrating phones, and they have tried or at least heard of force-feedback.

5.1 The Squeezeball

I have an idea for a haptic and tactile device for computer supported communication. It is a rubber ball with force feedback capabilities. The ball fits in your hand and the user can squeeze, shake, stroke, hit and interact with it however she wants. How a user interacts with it is reflected in the Squeezeball in the hand of the person she is communicating with. And it can vibrate, shrink, expand and mimic any type of touch. The force of the vibration or the magnitude of expansion will depend on the force applied to the transmitting ball. For example: if she squeezes, the other ball expands, if she shakes it the other one shakes, and if she bites it, sharp edges protrude from the other one, well maybe not too sharp.
5.1 The Squeezeball

It has a wireless connection to a mobile or stationary device like a PDA/mobile telephone or a PC through for example Bluetooth. It can also connect to other Squeezeballs directly. The ball has audiovisual capabilities as well. It can transmit light and change colour, it can receive and transmit audio.
This is of course just one idea of how such a device could be. One can imagine all sorts of systems, like a full body suit that can simulate any form of touch. However, I have decided to restrict my research to simpler forms of computer mediated haptic and tactile communication. The reason for this is that my education and research has shown me that the most successful devices or applications are the simple ones, not the ones that promises to solve all your problems with one click or claims to be as good as the “real thing”. I do not know of any system or object that is as good as the “real thing”. There are only real things, and imitations are other things. I do not deny the power of metaphors, they can help explain concepts in a clear understandable way. Nor is there any question that there are systems which mimic “real” things in a good way, but they seldom claim to be the same as a “real” thing.

G. Michelitsch et al. [94] suggests a similar concept for user interface controls called "Haptic Chameleon". It is a:

"computer-controlled user interface device that convey information to and from the user by altering their shape and feel. The user decides what a Haptic Chameleon control will do by changing its shape, and can immediately recognize the capabilities of the newly shaped device through haptic and tactile channels."
5.1 The Squeezeball

This is strictly HCI, but the concept of the device is very similar to my idea.

I will present a series of scenarios for use of this imaginary device. I want to show examples of usage, and especially informal and social usage which I think is important, I believe that a lot of researching energy goes into trying to create strict, formal tools for business and organizational environments. A lot of this is wasted, because it has been shown again and again that these kinds of systems have a high percentage of failure in that it is not used the way it was meant, or not used at all. I think most of them fail because:

1. Most of us are reluctant to use systems that are forced over our heads and which restricts us. Most people have "their own way of working", and no-one solves the same task exactly the same way and we have different approaches to problems.

2. We are social beings, and even if we are in a highly professional environment we tend to form social bonds to co-workers and most agree that a completely strict formal way of interacting in an organization is unhealthy and does not work well. Even in the military there is a certain degree of informality even if the command hierarchy is strict. Even the president of the United States of America jokes around in interviews, speeches and with co-workers and other state leaders. Otherwise he wouldn't be re-elected. No-one likes a person that is like a machine.

5.1.1 Technical

The device will need:

1. Battery.
2. Vibrator.
3. Expanding device. (Some kind of servo or electro magnet)
5.1.1 Technical

5. Pressure sensor.
6. Rubber coating
7. Integrated circuitry for processing data and controlling the devices.

For the development of the software, the device controlling the ball could use Java\textsuperscript{1}, and more specific J2ME\textsuperscript{2}. This because of the device independency of it, and the fact that existing small mobile devices do not support the complete Java framework.

The controlling device should have a network-, preferably Internet-connection or phone (GPRS\textsuperscript{3}) capabilities. I see the tactile communication as mostly a supplement for speech,

\begin{itemize}
  \item[1] \url{http://java.sun.com/}
  \item[3] General Packet Radio Service
\end{itemize}
5.1.1 Technical

so an advanced mobile pone (so called smart-phone) would be the best. Advanced, because I would also like to have IM’ capabilities.

5.1.2 Problems and Restrictions

A communication channel like this functions best one on one. The user would have to predefine communication partners or ask a new partner for a Squeezeball session. If someone squeezes you, you would like to know who it is before you squeeze back. If you have more than one partner you have to confer with the computer or mobile phone to find out who it is. This might be inconvenient. Maybe users will have only one partner who can squeeze without asking permission? A solution to this might be to exploit the audiovisual capabilities of the ball. Predefined colours for contacts identifies who squeezed you. A sound can also be used as an identifier. If the Squeezeball connects directly to a ball in the vicinity, they could both light up in the same colour, and the users would know who is contacting you. All these things would have to be user configurable.

5.2 Crystal Ball

How will it be used? I don’t know. It is hard to predict these things as history has taught us. The current extent and nature of the use of SMS², IM and even email was not foreseen by anyone. The air plane and the telephone was not seen as something for the general public when it first arrived.

However, I’m not saying that informal communication through haptic mobile devices will be the new thing, that will revolutionize our way of communicating. I’m saying that if I knew what I would find, there wouldn’t be much point in looking, but I can’t know of course and that’s what makes it exciting. And it is in line with my exploratory approach.

I have thought up a couple of scenarios that describe the usefulness of haptic communication and telehaptics.

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1 Instant Messaging
2 Short Message Service
5.3 Slap on the Back

I have observed in my own workplace, in other workplaces and in social/informal settings that it is very normal for co-workers and friends to shake hands, slap each other on the back or touch people on the shoulder as a sign of comfort, reassurance or sincerity. For example:

5.3.1 Meeting a Friend and Colleague

I observed in the café at my workplace, two men in their fifties, on seeing each other smiling, saying “hello” shaking hands and holding on to each others shoulders while telling each other how long its been since they saw each other and asking about each others work and personal life.

5.3.2 Celebration

I like watching documentaries about engineering projects on TV. For example; bridge building, searching for shipwrecks and demolitions. These are often huge, challenging projects which demands the best of every team member and the stakes are high in terms of money, prestige and very often the result affects thousands of people. During these projects the team members often form close emotional bonds with each other. This is because they rely on each other and they experience set-backs, disappointments and success. Invariably, these episodes are very emotional for the people involved. And hugging, back-slaps and touching are a part of it.

These are human interactions that are lost in a distributed environment. The Squeezeball might have the ability to support these kinds of interactions. It won't be the same, but it can be something similar. As i mentioned earlier people might see it as an intrusive or disruptive device that can destroy the routine they have of touching each other, because they will be held accountable for it and not everyone will be comfortable discussing or focusing on it, even if they used to do it all the time without thinking about it. However I believe that co-workers during an IM conversation, or a video-conference or together with an SMS message might use the Squeezeball to augment the communication. To
underline a point, or remind the other of an internal joke or other point not intended for anyone else.

### 5.4 The Company

Fred Johnson and Maurice Richardson started a high-tech company 4 years ago. They are developing a new revolutionary storage device for computers. It's still in the research stage, but their stocks are extremely popular on the stock exchange and the company is worth a lot on paper. It is important for them that the market, potential investors and partners have faith in them. But they can't reveal too much of their technology. So, this is not an easy task, they must weigh every word they say in public.

Fred is the businessman and Maurice is the scientist and not much of a public speaker. Fred is the one that holds press conferences and Maurice tries to tell him what he can and can't say about the technology. Maurice also says a few words now and then and Fred tries to tell him what he can and can't say to the market, in order to keep the stock prices rising. They try to prepare as much as they can before press conferences and business meetings, but they can't foresee everything. Often people ask tricky questions and try to lure out information.

They experience that it's interpreted as negative if one of them interrupts the other in the middle of an answer. People see this as a sign that everything isn't as it should be.
Fred had discovered a new product called “the Squeezeball”. Being the modern innovative characters they are, Fred and Maurice decided to try it out. This could give them the hidden form of communication they needed. The device was easy to connect to their mobile phones, which they always had on them anyway, and so they tried it out. The first few times they had problems interpreting the other, but after a while they developed a quite advanced form of language which enabled them to encourage, warn, stop and question the other through the Squeezeball.

At the next press conference Maurice was able to control Fred’s runaway tongue without anyone else noticing.
5.5 Crane Operator

Erik Berg works as a crane operator for an entrepreneur company specialized in high rise buildings. One of his main jobs is to lift large and heavy components and place them at the exactly right spot on the building. To accomplish this he needs audiovisual contact with a worker (Johan Larsen) on the building who tells him to lower, hoist or move left, right, forward and backwards. The margins are extremely small and it can also be dangerous to come in the way of the large concrete building blocks.

Johan communicates visually with Erik through hand movements. But sometimes Erik is too far away or the line of vision is blocked and they have to rely on radio communication alone. Erik finds this very stressful. It is hard to communicate exactly how much he needs to move the object only through words and they have a considerable time pressure.

Someone in the company suggested replacing Erik with a remote controlled crane which Johan could operate directly. This was dismissed as being too expensive and the Union did not like the idea of firing Erik. Also, it's not only Johan Erik cooperates with, he delivers objects all over the construction site. So they would need to give control over the crane to several people, and how to switch safely between them was an issue they didn't have a solution for.

Then they discovered a new product that could make it possible for Erik and Johan to communicate haptic. Johan had two joysticks with which he could control all movements of the crane. However he didn't control it directly, but through Erik who had a force feedback device on his joysticks. When Johan pulls his joystick in one direction, Erik feels a tug in his joystick in the same direction. Erik is still in control, but is guided along in the operation. Johan has also a panic button which causes a bright red light to flash in Erik's cockpit, on which Erik stops the crane.

Erik found this solution a lot less stressful and more precise. He didn't have the constant radio chatter in his ears, not only from Johan, but from others who wanted his attention. Also, he could feel exactly where Johan wanted him to put objects.
5.6 Real Life Example

I remember a press conference during the 1. gulf war, where someone was speaking to the press and answering questions. Behind him stood general Schwartzkopf. Several times, Schwartzkopf took one step forward and in a said in low voice “I wouldn't go into that”. Schwartzkopf tried to do this behind the speaker and the public was probably not supposed to hear it, but the microphone caught it all on tape. This would have been a perfect situation in which to use the Squeezeball. Schwartzkopf could have squeezed his ball every time the speaker had to watch his tongue. They could also develop a more sophisticated language where the general could encourage, warn, stop and so on.

A more recent, but similar example is George W. Bush Jr. during his last presidential campaign. During a speech he was accused of having a radio transmitter on his back, and a speaker in his ear presumably for receiving coaching from advisors. I do not know if it was true or not, but a haptic device could have been used, and would be undetectable for the audience. Although it might not be able to convey as complex data as an audible device could, it might be less disruptive for the speaker.

5.7 Socialisation and Teenagers

Youth at ages 12 to 18 are very active in using IM and SMS to keep in touch with their friends. The desire for availability, and the need for acceptance within the peer group are at their peak at this age. Having friends and interacting with them is a huge part of growing up and development of personality. As these types of communicating have developed and become very popular they invariably will affect this process of socialisation. In the mid 90’s, before mobile telephones became common, many young people had pagers which could receive numbers. They developed a complex system of codes which were translated to expressions teenagers use a lot, like: “I love you” and “thinking about you”, this shows how much these kinds of systems are appreciated by teenagers especially when they made this much effort to use a system that by today’s standards seem cumbersome.

“It facilitates communication and the ability to coordinate among peers at a point in one’s life where social accessibility is paramount. In addition, it has a very strong
5.7 Socialisation and Teenagers

symbolic meaning. It is, in effect, the assertion of emancipation as the device allows for social coordination unfiltered by one’s parents.”[95]

The mobile phone, IM and SMS has had a huge impact on children and teenagers as well as everyone else. These technologies allows them to be accessible, coordinate and generally keep in touch with friends and current events. I have little to base any assumption on the quality of these interactions, however it is obvious that the amount and effectiveness of communication between teenagers have increased. I remember from my own adolescence, when I rode around on my bike trying to locate my friends, this is unnecessary now and in effect increases the time spent interacting with peers. However I can't say if the amount of face to face interaction has increased or decreased. But it is safe to say that the amount of non-face to face communication has increased. So, if socialisation is important for teenagers development into adulthood and the most important factor is their interaction with peers, I believe that augmenting their non-face to face interaction mediums with the sense of touch it could be a fun, interesting and useful tool. And that is where the Squeezeball might come in as an augmentation of the communication and socialisation process.

I can imagine teenagers and younger children using the Squeezeball as a way of keeping in touch with their friends, girl/boyfriends, siblings and other family together with IM, SMS and telephone.

5.8 In the Classroom

It's fairly non intrusive nature is ideal for a classroom setting. Although I would not recommend it, because although it is less intrusive than sound, it would disturb the concentration of students and disrupt the learning environment. But I believe it might be fun for teenagers to use to keep in touch with their friends. Passing of secret notes and throwing paper balls has always been popular in these settings. The teacher would probably confiscate the devices, but that does not hide the fact that it would be fun.
5.9 At Night

Children, teenagers, close friends and lovers might use the Squeezeball to keep in touch in a non-intrusive way, just to say good night or hello. This way, all you have to do is squeeze back and that says what you want it to say from the context you are in.

5.10 At the Club

There exists today systems for mobile phones with Bluetooth which establishes connections (ad-hoc networks) with other phones as soon as they discover them. For example: you walk into a room with people in it, and one of them has a phone with this system and you suddenly get a message on your phone form this person. It is automatically sent from his phone when it discovers yours. RFID devices are also capable of this, and there are new systems developed and introduced using it now, but they are as far as I know not suitable for human to human communication.

The Squeezeball could also be used like this. A ball which discovers another ball could start glowing in pink and ask the other ball to glow too at the same time as it sends a squeeze. This would allow people to see who sent the squeeze, and who received it, if that is what they want, otherwise it could be a secret. This could be fun and function as an ice-breaker.

Because of the noise levels at clubs or concerts a haptic device for simple communication could be useful. You could tell a friend to squeeze you when he gets there so you can meet at the bar, or you can squeeze back in a way which tells him you are busy.

5.11 At the Convention

The functionality I described in chapter 5.10, could be used on conferences or conventions where participants in a particular research group do not know each other, or have only communicated with people through email and telephone, but you have never met them in person. They could agree on a pre-set code, squeeze and glow colour for the Squeezeball. Then the Squeezeball could tell them if they were in the vicinity of a member of their research group. I do not know if this would be better than signs and name tags, but maybe a welcomed fun change. A research group could sit on a table with their
5.11 At the Convention

Squeezeballs on the table and if a member of their group walked by, the table would light up.

This could also be fun for blind dates. Instead of the rose in the button-hole.

5.11.1 Secret Handshake

Put it in your pocket, when the secret haptic movements of the ball comes, you know you are close to a “brother”.
6 Discussion

In this chapter I will first present an extreme vision of computer mediated human to human communication, and then go on to discuss a few claims which one might come to from going through the research I have presented.

I have done what I said I would in my problem definition. And now it is time to discuss what relevance or impacts this research might have.

6.1 Extreme Vision

I will present this vision to put things in perspective and position this thesis in the research spectre. I think it can help to clarify my research to show what is outside the scope.

One vision of computer mediated communication can be people all over the world, in VR (Virtual Reality) suits, goggles, ear phones and a system for generating smell, communicating with each other over vast distances, in a complete VR environment, where they perceive each other, objects and the virtual world as completely "real" and indistinguishable from the physical world. We can even imagine a system that communicates directly with the brain so you will not need a suit or goggles. This raises some philosophical questions; what is real, what is true and what is physical. We perceive the world through our senses. But what we perceive is just our body's and brain's way of interpreting light waves, sound waves, heat and matter in a way the brain can process to help us navigate and communicate in the world. There is a huge amount of information that our body does not register. What we see is just a small part of the spectre of electro-magnetic waves around us. We can not see or feel normal radio-active radiation and the sound frequencies and decibel levels we can hear are also just a part of the possible spectre of pressure waves in the air.

There is an old philosophical question: “If a tree falls in the wood and no one is there, does it make a sound?” It produces waves of compressed air but it is our brains which interprets this as sound. Now if you turn it around and say: “If you perceive a tree falling in
6.1 Extreme Vision

the woods, but it is only an artificial rendition projected directly to your brain, does it make a sound?"

However, this kind of computer mediated communication is not here yet, and the research I have gone through is far from this. But I mention it here because this is a future that might be the result of research on computer mediated human to human communication, but which is not a goal for most researches in this field. This is also a good place to remind ourselves that most of the world has never made a phone call, much less browsed the Web [96].

6.2 What Have I Done?

I have now gone through research in different fields and tried to show that informality and touch are important in how we communicate. I have also shown how it can be incorporated in the form of informal telehaptics.

6.3 Do We Need This?

"Hvis du ser visesanger Lillebjørn Nilsen slepe seg ut til en drosje med bagasje og gitarkasser, vil du neppe tro at innerlommene er fulle av elektronisk kommunikasjonsutstyr som gjør han i stand til å nå resten av verden både skriftlig og muntlig uansett hvor han befinner seg. Er du uklok og forsøker og gjøre billige poenger av en "enkel" visesanger som utstyrt med gitar, munnspill, munnharpe, feler og fløyter, drasser rundt med fremmedgjørende teknologi, vil han se forundret på deg og fastslå rolig at "alt dreier seg om kommunikasjon". "[97]

This is a quote from the sleeve of a record by the Norwegian folk-singer Lillebjørn Nilsen, which speaks of the apparent paradox of a simple musician on tour lugging around alienating communication technology, while Lillebjørn states that; It's all about communication. A statement which disarms claims which says that modern communication technology isolates or alienates us. This is also discussed in Rheingold, 1999 [98], which describes a controversy in the Amish community over the introduction of
6.3 Do We Need This?

mobile phones. The Amish have a very conscious attitude regarding technology. To them the important things are to keep the community together and separate from the rest of the world. So they approach new technology cautiously and question its benefit for them as a community. They don't shun all technology, but they have very strict demands to it, which in many ways is healthy.

There is no doubt that for example the mobile phone and email is a success, meaning it is used a lot. People in the industrialised world communicate more now than 200 years ago, with more people. Unlike the Amish, we already have several means of modern types of communication tools that most of us have adopted for different reasons; because we had to in our work, because we thought it was cool, because we saw that it could benefit us and those around us or simply because it was available, cheap and convenient.

I have a suspicion that some of us adopt some technology without thinking to much about why. We do it because we can. Did people realize their border between work and home would deteriorate? Did we realize we would stop going on surprise visits without calling first? Did we realize we would stop making appointments, and receive calls 5 minutes before the meeting saying “I will be late.”

Perhaps we work and live more distributed now because technology enabled us to, not because we wanted to. This is where the Amish approach is appealing, because they are so conscious about which technology to adopt. They think about what would benefit them as a group. What brings them together and what pushes them apart.

I-tema are researching identity in distributed environments. Because they have seen a need for this. There might be a concern that people become isolated when they only communicate electronically with the organisation they work for. This also concerns us on a private level regarding family and friends.
6.3 Do We Need This?

Would the introduction of telehaptics bring us together or push us apart? Some research I have presented suggests that at least when we already live and work in an distributed environment, the sense of touch might help us feel closer.

Face to face communication is very complex. And the amount of communication going on between two people in this form is enormous. I do not think it is a controversial claim to make that for most people face to face communication is important. However, many interactions are best suited to go through other media. An unpleasant confrontation might be better in the form of an email. And the phenomenon of "Flaming", were people behind a veil of anonymity write harsh comments on the internet which they would not say face to face or with their own name under it, also illustrates that face to face can be restricting (sometimes for our own good). Sometimes we avoid face to face interactions because it would be too overwhelming or because we do not dare. This is because of the power of the communication form.

The quality of the communication is hard to measure though, and is at the heart of the topic of this thesis. Would the introduction of touch as a means of computer-mediated communication increase the quality of communication?

Compared to people's tools for communications 200 years ago, before the telegraph, I would argue that we not only have more, but richer media for communication. By that I do not mean to say that SMS is a richer media than good old-fashioned face to face communication, but all forms of communication that are available to us now combined gives us a richer form of inter-human communication. One can argue that we have been alienated from each other by communicating through computers and being dependent on machines to do it, but through my research I have found little evidence for this.

Through my presentation of research, and Nardi [2] showed a good example of it, I think I have shown that all types of communication technology adds richness. This is of course if it does not come at the cost of other media. For example if we stop seeing each other
because of the mobile phone. But I do not think this is the case and I think all communication media complement each other and if combined can add new dimensions again. As a consequence of this I believe that the introduction of touch and a broader focus on informality will add to our already rich world of communication.

Modern communication technology support informal/light weight communication to some degree, but touch to a much less degree. And although I have described some research projects which have developed some simple prototypes for telehaptics, there are none commercially available, but Cute Circuit plans to make the Hug shirt available soon. Informal and lightweight communication is supported to various degrees and in different ways by different media as I have shown. Most of it is of course up to the user. Human beings have a great ability to adapt systems to their needs, but it can help to focus on designing systems to support this.

Why should communication systems support informality? I think this is self evident to most people, but I have also presented serious research which shows that is is important at the workplace. That informal communication enriches life outside the workplace is also something most people will agree on. Most of us do not want to communicate through standard forms or never be able to joke argue with each other. Nardi [2] showed that social, and informal types of communication is very important to an organisation and to people in the organisation. It is important as a coordination tool, and a purely social tool. I think I showed in chapter 3.2, that informality in communication is important to us, privately and professionally. And I also showed that informality supports other kinds of communication. For example: for researchers cooperating on a paper. They are more likely to cooperate if they have the channel for informal communication, but the result is a formal paper, and no doubt they must have had some meetings and other communications with a high degree of formality to be able to deliver it.

By enriching, I mean any form of channel or attribute that is added to what we can use as communication. If I can communicate with you only through knocking, adding a flashing light, enriches our communication. And if we have all normal modern tools available for communication, and I also get a bullhorn, it enriches, but does not improve our
6.3 Do We Need This?

communication perhaps. So I believe beyond doubt that informality is both important and enriching as a channel or a form of communication.

I think touch is important and enriching, for many of the same reasons that informality is. Touch definitely adds something to the communication, and it is social. That computer mediated touch is social, is perhaps less obvious and needs further research.

In Brave [26] they did some very important discoveries. It concerned among other things the feeling of power, liking, positive affect. I repeat these here:

1. Contrary to expectations, cooperative participants trusted their ostensible partner less when interacting via haptics as compared to visuals.
2. Touch participants felt more powerful in the competitive condition, but less powerful in the cooperative condition.
3. Under competitive conditions, the participants had much more positive feelings in haptic mode than in visual.
4. Participants liked the competitive partner best in haptic mode.
5. Contrary to expectations, cooperative participants trusted their ostensible partner less when interacting via haptics as compared to visuals.

“The underlying sentiment is often that the added dimension of touch will inherently lead to more efficient and satisfying interfaces. The results of the present study, however, indicate that the effect of mediated touch can be positive or negative, depending on context. Much as touch in the real world, mediated touch is a psychologically complex phenomenon, requiring careful consideration before use.”

I agree with this. But it is a research focused on solving a specific task, or work. InTouch was more focused on the abstract nature of interaction and I would have liked to see a formal test of it to see how it could be used and what people could gain from it. When they designed and tested the ComTouch [90], they again focused on solving a specific task and their conclusion was that you can send information through haptics, but nothing about the nature of haptic communication other than that other people can not hear it, so it has a
potential of privacy. The Hug-Shirt is more up my alley. They focus on people, and how people are social beings who, some more often than others, needs to be hugged. They are planning to commercialise it, so that must mean they believe in it.

I think touch can be an important addition to informal communication, because it supports many of the same features that IM does, which has proven to be a successful tool. It is lightweight and unintrusive at the same time as it can give a sense of intimacy. Haptic systems might have an advantage in this respect. Because it is more difficult to log haptic interactions, the informal nature of it and its limited ability to convey complex information, makes it less likely to suffer the same fate as Lovejoy & Grudin[94] suggest IM might do.
7 Conclusion

My task was to:

1. Describe research about informality in communication.
2. Describe research about the application of touch in communication.
3. By way of scenarios, illustrate how touch can be used to support informal social and professional interaction in a distributed environment.

I believe I have done this, and to sum up I have found that research support:

- Informal communication is important in all areas of our lives; professionally, privately and socially.
- Different media support and are used for different types of communication.
- Systems for computer mediated human to human communication benefits from supporting informal communication.
- I found that touch is a powerful means of communication, and that computer mediated touch can convey information between people.
- I found that the field of haptics is an emerging popular field right now.

I suggest that a communication tool based on touch, that is light weight so it supports informal interaction will be a useful contribution to our everyday communications needs.

From my review of research I have concluded that research from the perspective of ICT has traditionally focused mostly on specific work tasks. It is only natural, and not a bad thing. Most research is financed by someone who wants some kind of result they can use for something, they want an answer to a problem. On the other hand a lot of interesting and exciting findings comes from research without a clear problem to solve or as a side effect of traditional research.

But I think there is a need for research more focused on people and quality of life, from an ICT perspective. The main focus usually is on solving specific work related tasks. I have
an impression that the subjects of sociology and psychology has come further in this aspect, so informaticians should (and many do) draw more on their knowledge. This type of research embraces very different subjects, like psychology, sociology, informatics and many more which from an educational point of view is a challenge.

7.1 Future Work

I think the world is ready for a commercially available telehaptic system for informal communication between family, friends and colleagues. If such a system comes along, I would be very curious to see how and if it will be used and I am sure there would be done research on it.

There is currently much research going on in the field of haptics. The first, according to the host, international workshop on haptic and audio interaction design is august 31, 2006 [99], and several parts of the program at the CHI 2006[100], which boasts to be the premier international conference for human-computer interaction, are concerned with haptics and some with informal communication.

And there also seems to be a growing interest in studies which moves away from solving work related tasks and more on observing inter-human phenomenon.

The future is tangible!
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